Rice University

Department of Chemical and Biomolecular Engineering

CHBE 301 CHEMICAL ENGINEERING FUNDAMENTALS

Course Syllabus | Fall 2019

Instructors

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Class schedule and location

CHBE301.002 (CRN: 11028): 9:00 to 9:50 am MWF in DCH 1046

Office hours

By appointment, or according to the schedule provided on Canvas.

Course description

This course prepares students to formulate and solve material and energy balances on chemical process systems and lays the foundation for subsequent courses in thermodynamics, unit operations, kinetics, and process dynamics and control. More fundamentally, it introduces the engineering approach to problem solving: breaking a process down into its components, establishing the relations between known and unknown process variables, assembling the information needed to solve for the unknowns, and finally obtaining the solution using appropriate computational methods.

Course Objectives

After completing this course, students will be able to:

- Solve material and energy balance problems using both mass and molar bases in both SI and American units.
- Convert between common temperature, pressure, mass, and composition scales; describe the difference between vacuum, gauge, and absolute pressure scales and the absolute and “common” temperature scales.
- Solve material balance problems for processes which may involve recycle and/or purge streams, chemical reactions, or multiphase equilibria.
- Solve simple liquid-vapor equilibrium problems using Raoult's law and/or tabular and graphical data; sketch simple phase diagrams and label phase boundaries.
- Perform combined mass and energy balances on process which involve heat, work, and chemical reaction terms.
- Solve material and energy balance problems for transient processes.

ABET Student Outcome to be assessed

SO 3 An ability to communicate effectively with a range of audiences.

Topics covered

1. Introduction to engineering calculations
2. Processes and process variables
3. Fundamentals of material balances
4. Single-Phase systems
5. Multiphase systems
6. Energy definitions and energy balances
7. Balances on nonreactive processes
8. Balances on reactive processes
9. Balances on transient systems

Textbook

- Felder, R.M., Rousseau, R.W., Bullard L.G. Elementary Principles of Chemical *Processes*. 4th ed. 2015, Wiley.

References

- Himmelblau, D.M. and J.B. Riggs, *Basic Principles and Calculations in Chemical Engineering*. 7th ed. 2004, New York: Prentice Hall.
- Murphy, R.M., *Introduction to Chemical Processes, Principles, Analysis, Synthesis*. 2007, New York: McGraw-Hill.

Academic Integrity

- Students are required to review and abide to the *Rice Honor Code*, which can be found at honor.rice.edu. After reading the Constitution of the Honor System, the *Honor Pledge* should be signed, dated and returned to your instructors.
- It is the instructor's understanding and expectation that the student's signature on any test or assignments means that the student contributed to the assignment individually and that he or she neither gave nor received unauthorized aid. Authorized aid on an individual assignment includes discussing the interpretation of the problem statement, sharing ideas or approaches for solving the problem, and discussing the necessary concepts. However, it is expected that the students will submit their own work. Referring and/or copying solutions from answer keys given in previous semesters and/or from solution manuals is forbidden. Failure to comply with this policy will be immediately reported to the Honor Council for further actions. This policy will be strictly enforced.

Attendance

- Class attendance is mandatory. Students are expected to attend all of the classes. Missing a class due to unexcused absence will be counted as an absence and materials –including homework, quizzes, and exams– cannot be made up. Excused absence must be authenticated and brought to the instructor immediately (within a week) to qualify for permission to make up any missed exam. **If qualified, homework can be turned it, and although quizzes cannot be made up, the missed quiz grade will be computed using the grade average of the other quizzes.** Students should realize that the instructor has the right to refuse authenticated excuses if he or she observed regularity of such manner.
- Lateness to class is not acceptable. Leaving class while the instructor is lecturing is impolite and disrupts the class; therefore, students are required to remain seated until the end of the lecture and leave only in the case of an emergency.

Instructor's Commitment

- Students should expect from his or her instructor to be courteous, punctual, well-organized and prepared for lecture and other class activities. Furthermore, instructors should answer the proposed questions clearly; be available during office hours or notify the students beforehand if they are unable to keep them; and grade uniformly and consistently according the posted guidelines.

Disabled Students

- Students with any type of disability –physical, learning, etc. – should seek assistance from the Disability Support Services in the Ley Student Center in order to obtain official documents and submit it to his or her instructor. Such situation will be dealt with on an individual basis.

Homework

- Homework will be given on a regular basis and it will be due at the beginning of class on the specified date. Homework problems will be posted on the *Assignments* section of Canvas. Discussion of strategies of solution, revision of the procedure and final answers may be consulted with the instructor or the teaching assistants. Homework problems are excellent for practicing solution strategies, and quizzes will be based solely on homework problems (i.e. if you know how to solve the homework problems you should not have difficulties solving the quiz problems). Solutions to the assigned homework problems will be provided. However, it is the student's responsibility to fully understand the solution of every assigned problem and ask for help, if needed.

Quizzes

- Quizzes will be normally given the following class after the day the corresponding homework is due. Quizzes will be either held in class or will be posted on Canvas. The content of the quiz will focus on the material covered in the corresponding homework. Quizzes will be either closed or open book (closed notes in all of the cases) depending on the nature of the material covered in the assignment. Students will be informed accordingly.

Exams

- There will be two exams during the semester and a comprehensive final exam.
- The first two exams haven been scheduled as follows:
    - First exam: October 2nd, 2019, 7:00 – 9:00 pm | Location: TBA
    - Second exam: November 15th, 2019, 7:00 – 9:00 pm | Location: TBA
- The date and time of the final exam will be posted on Canvas as soon as they are defined by the Registrar's Office. All of the exams will be open book and closed notes.

Final Project

- A comprehensive project addressing most of the topics covered in this course will be assigned and worked in teams of 4-5 students. A handout including the requirements of the project, objectives, contents, and deadlines will be provided separately.
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Grading Policy

Attendance & Participation	5%
Homework	15%
Quizzes	15%
Exams #1 and #2	30%
Final Project	15%
Final exam	20%
TOTAL	100%

The final letter grade is determined as follows:

Grade	**%**	**Grade**	**%**
A+	≥ 97	C+	77.0 – 79.9
A	93.0 – 96.9	C	73.0 – 76.9
A-	90.0 – 92.9	C-	70.0 – 72.9
B+	87.0 – 89.9	D+	67.0 – 69.9
B	83.0 – 86.9	D	63.0 – 66.9
B-	80.0 – 82.9	D-	60.0 – 62.9
		F	<60

The **lowest quiz grade will be dropped** at the end of the semester. Grades in this course will not be curved. It is theoretically possible for everyone in the class to get an A or an F. Your performance depends only on how you do, not on how everyone else in the class does. It is therefore in your best interest to help your classmates, while acting within the bounds of the academic integrity policy. In borderline cases, student's grade may be raised at the end of the semester if justified by attendance, homework, participation and general academic performance.

If a student believes that an error was made in grading a quiz or exam, he or she should see the instructor within one week after the quiz or exam is returned. For exams, it must be noted that the entire exam will be re-graded not just the problem in question, in order to ensure consistence and fairness.